CPSC 322, Practice Exercise
Solutions to Arc Consistency

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1 Directed Questions

- What does it mean for an arc to be consistent? **Answer:** An arc $< X, r(X, Y) >$ is arc consistent if for each value x in $dom(X)$ there is some value y in $dom(y)$ such that $r(x, y)$ is satisfied.
- How can we enforce consistency of an arc $\langle X, r(X, \bar{Y})\rangle$? **Answer:** Remove all the values x in $dom(X)$ for which there is no corresponding value y in $dom(Y)$ that satisfies the constraint.
- What does it mean for a network to be arc consistent? **Answer:** All of its arcs are consistent.
- What are the possible outcomes of the arc consistency algorithm? **Answer:** At least one domain could be empty, in which case there is no solution. Each domain could have a single value, in which case there is a unique solution. Or some domains could have multiple values.

2 Arc Consistency

Consider the case where the arc consistency algorithm terminates and some domains have multiple values. Is there guaranteed to be a solution? Consider the CSP problem in Figure 1.

Answer: No, there might not be a solution. In this example shown in Figure 1, no values are removed from any of the variable domains during arc consistency, but there is no solution to the problem.

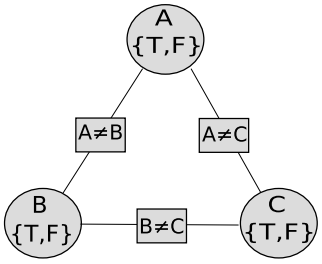

Figure 1: Sample Constraint Network

3 Learning Goals

You can:

- Build a constraint network for a set of constraints.
- Verify whether a network is arc consistent.
- Define/read/write/trace/debug the arc consistency algorithm. Compute its complexity and assess its possible outcomes.
- Define/read/write/trace/debug domain splitting and its integration with arc consistency.